Calibration of the VISTA Hemisphere Survey (VHS)

Richard McMahon (VHS PI)

Institute of Astronomy

University of Cambridge

Visible and Infrared Survey Telescope for Astronomy

- 4.1m primary mirror, wide field survey telescope
  - Altitude-Azimuth mount; f/1 primary; f/3.25 cassegrian focus
- 1.65degree diameter field of view
- Located at European Southern Observatory (ESO) , Paranal near the VLT site.

- Infra Red camera only
- Sparse filled mosaic of 16 2k × 2k IR detectors

- Design and construction was a UK project
- VISTA is now an ESO facility (as part of ESO late joining fee)

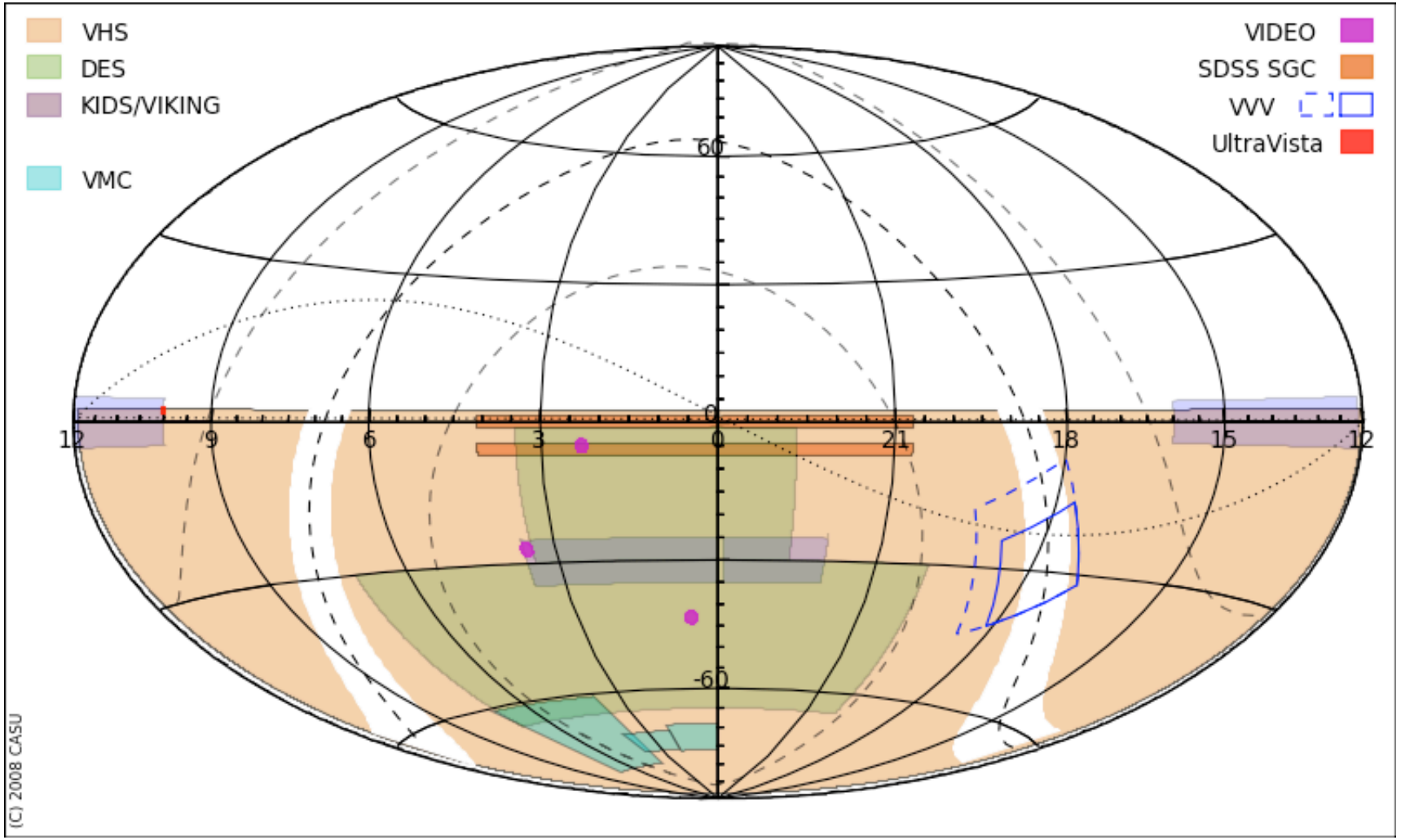
VHS Survey Summary

- Time allocation: Nominally 3100 clear hours including overheads (345 9hr nights) over 5 years starting mid-2009

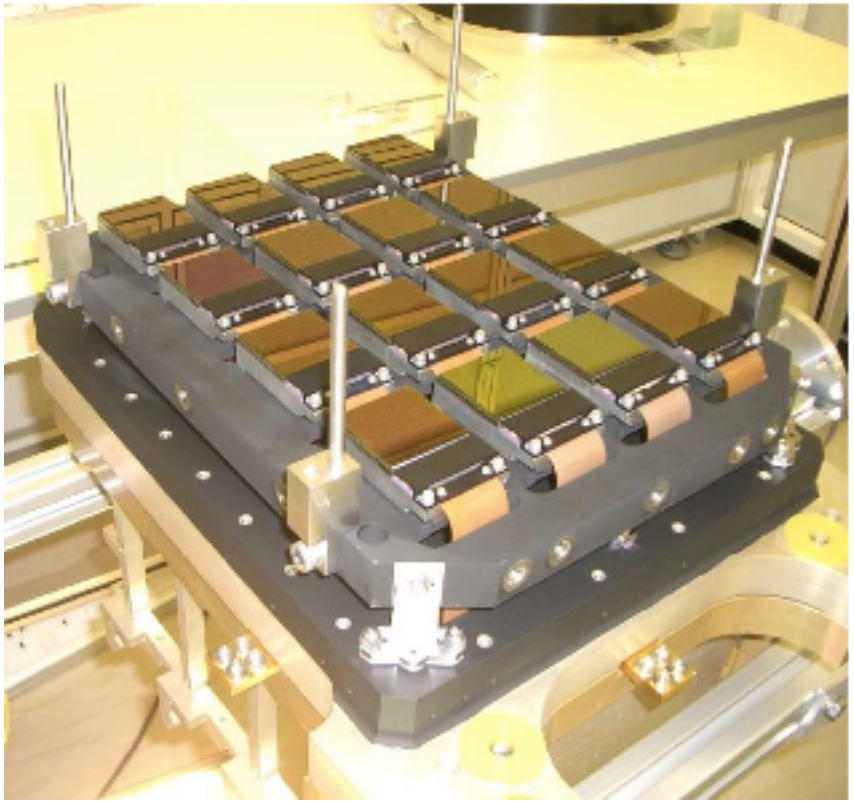
- VHS-Dark Energy Survey (VHS-DES)
  - |b| >30; 4500deg^2 (excludes 500deg^2 from VIKING footprint)
  - 140 clear nights (40% of total time)
  - J (120sec), H(120sec), K(120sec)
  - Magnitude limits(AB: 5σ): J=21.2; H=20.8; K=20.2

- VHS-ATLAS
  - |b| >30; 5000deg^2 (excludes DES footprint), 125 nights
  - Y(60sec), J(60sec), H(60sec), K(60sec)
- VHS Galactic Plane (VHS-GP)
  - 5< |b| <30; 8200deg^2 ; 85 nights
  - J(60sec); K(60sec)

VHS Sky coverage footprint

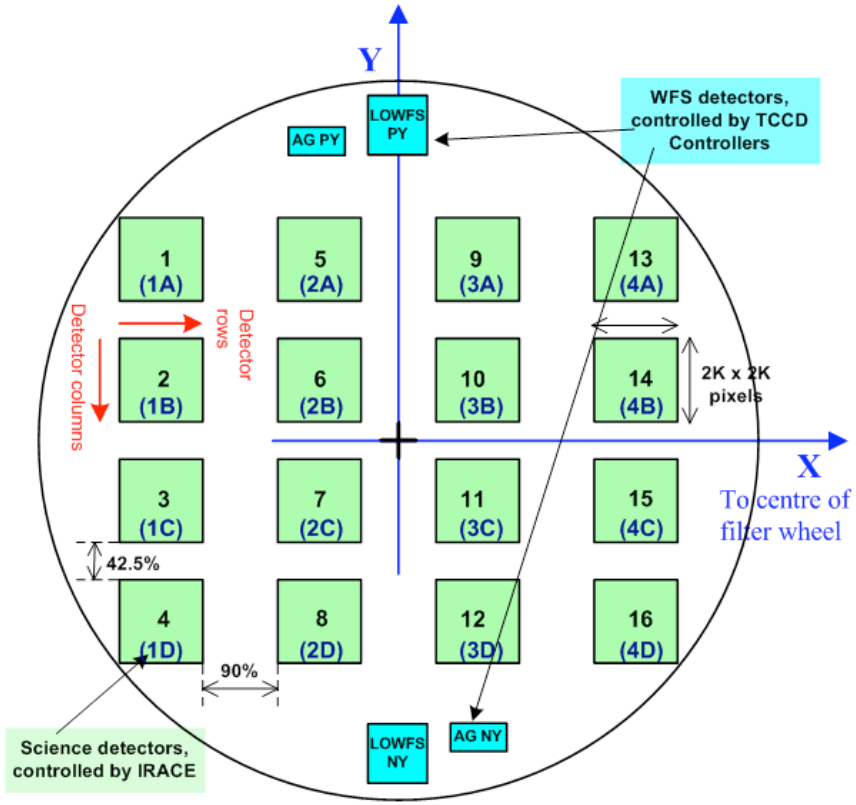


VISTA Focal Plane



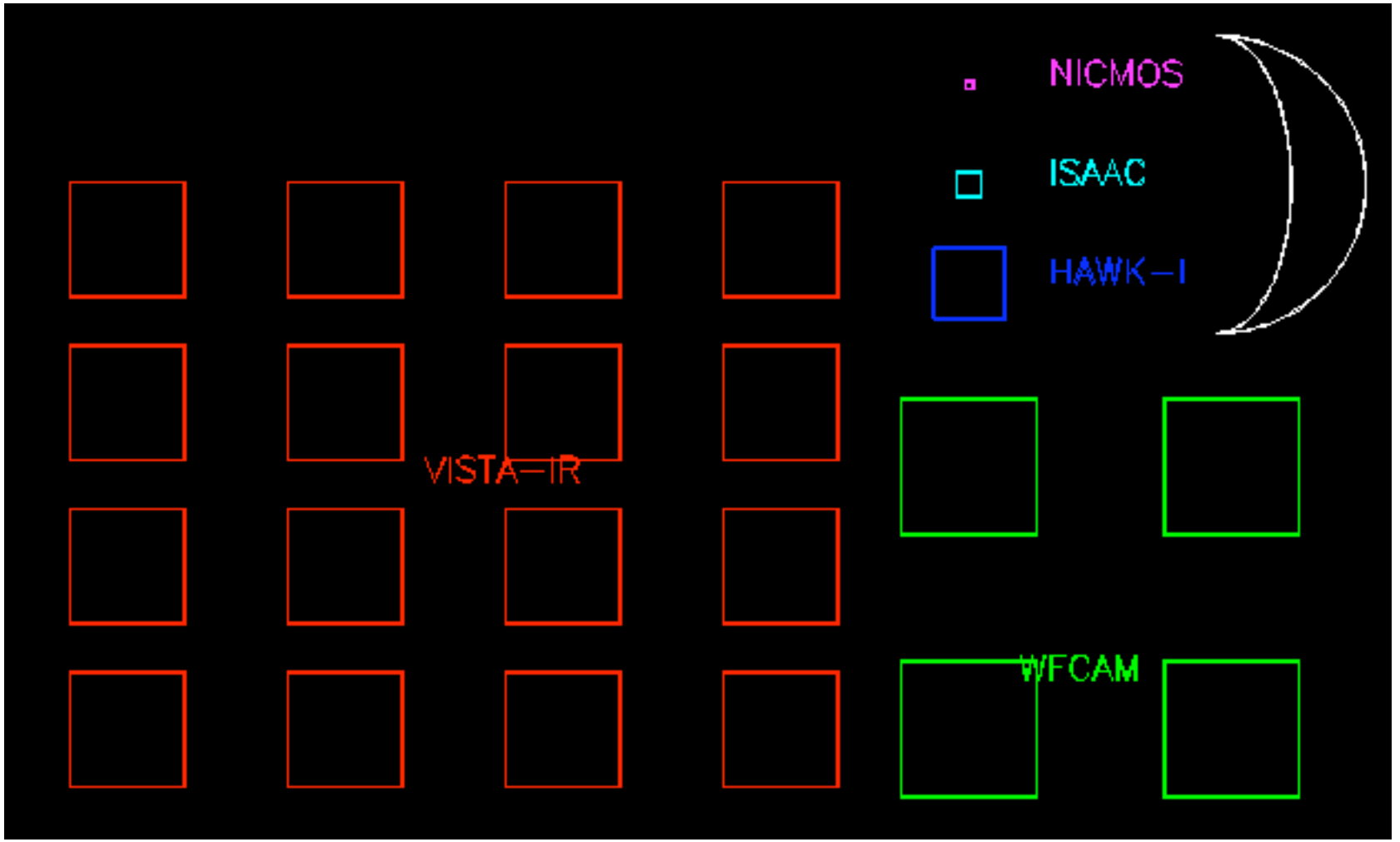
- 16 Raytheon VIRGO 2k × 2k detectors
- 67 Million pixels
- 4 × 4 sparse array
- Spacings 90% & 42% of a detector
- 0.34” pixels

VISTA Focal Plane



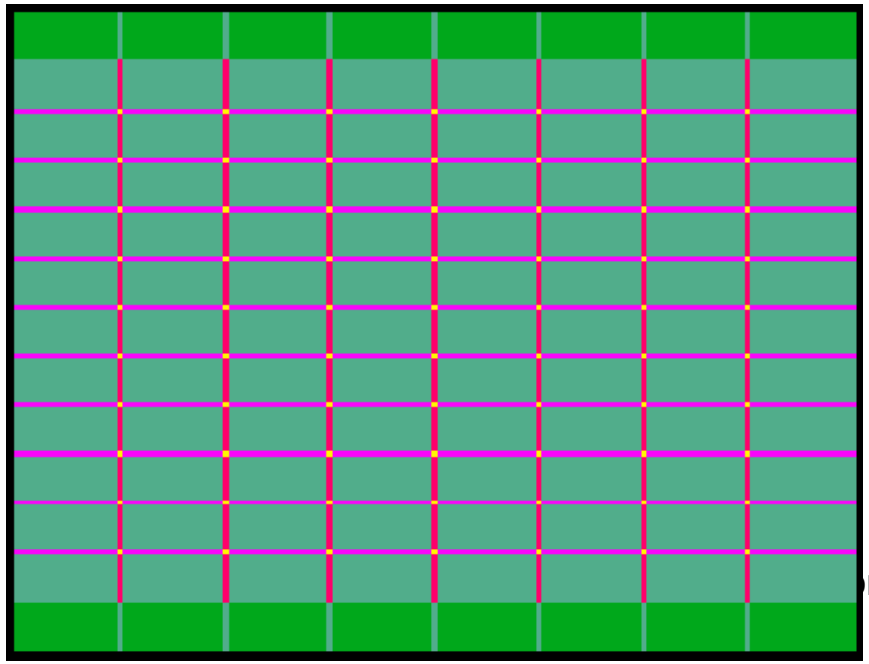
- 16 Raytheon VIRGO 2k × 2k detectors
- 67 Million pixels
- 4 × 4 sparse array
- Spacings 90% & 42% of a detector
- 0.34” pixels

IR camera field sizes:



VISTA Tile

- 6 pointings are required to give a contiguous ‘tile’
- 1.017 deg x 1.475deg = 1.501 deg2 sky is covered (by a minimum of 2 pixels) as shown in light green in the exposure time map below for a filled tile.
- Every sky pixel covered by ≥ 2 pointings
  - Assumes dithering to remove bad pixels
- VHS has yet to decide PA or 0 or 90; 90 favoured
- Tiles will overlap by at least 1’ on each side



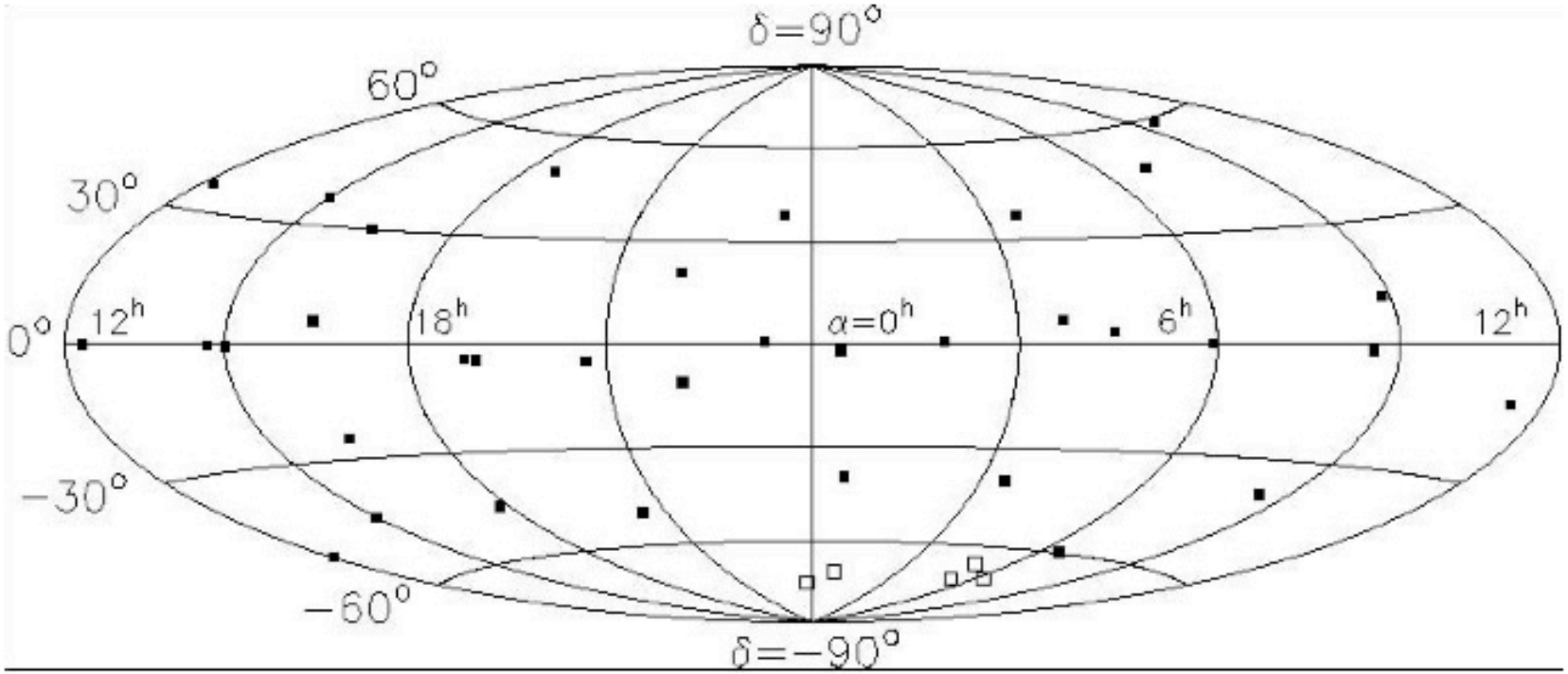
Relative Exposure Time
dark green = 1
light green = 2,
magenta = 3
red = 4
yellow = 6

VISTA Calibration

- Will follow UKIRT WFCAM procedures
  - see Hodgkin et al, 2008, astro-ph/0812.3081
- Linearity determination and correction required
- Astrometric calibration uses 2MASS
- Photometry tied to 2MASS (J, H, K)
  - Z and Y also calibrated using 2MASS
  - Radial distortion correction applied to catalogues
  - Spatial systematic correction map for 5% corrections

VISTA Photometric Calibration

2MASS Touchstone Fields



Astrometric Calibration 2MASS

WCS - ZPN projection

$$r' = r + k_3 r^3 + k_5 r^5 \ldots$$

Linear solution per detector

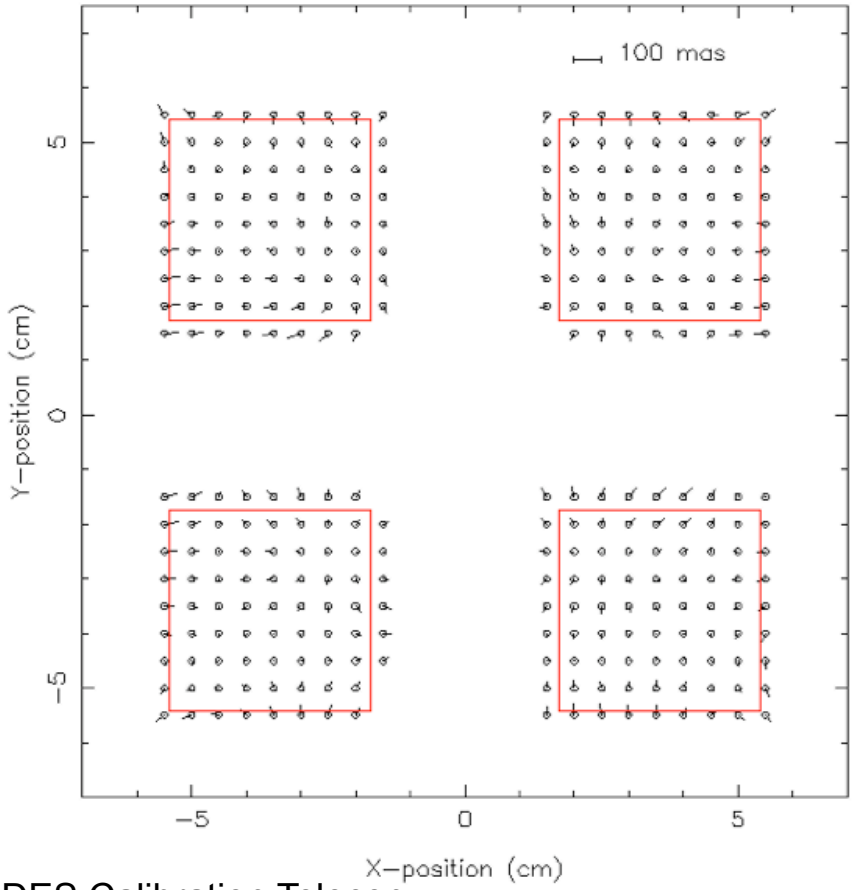
$$\xi' = ax' + by' + c$$

$$\eta' = dx' + ey' + f$$

⟶ rms < 100 mas

Tabulated systematics from stacked residuals

⟶ sys < 25 mas



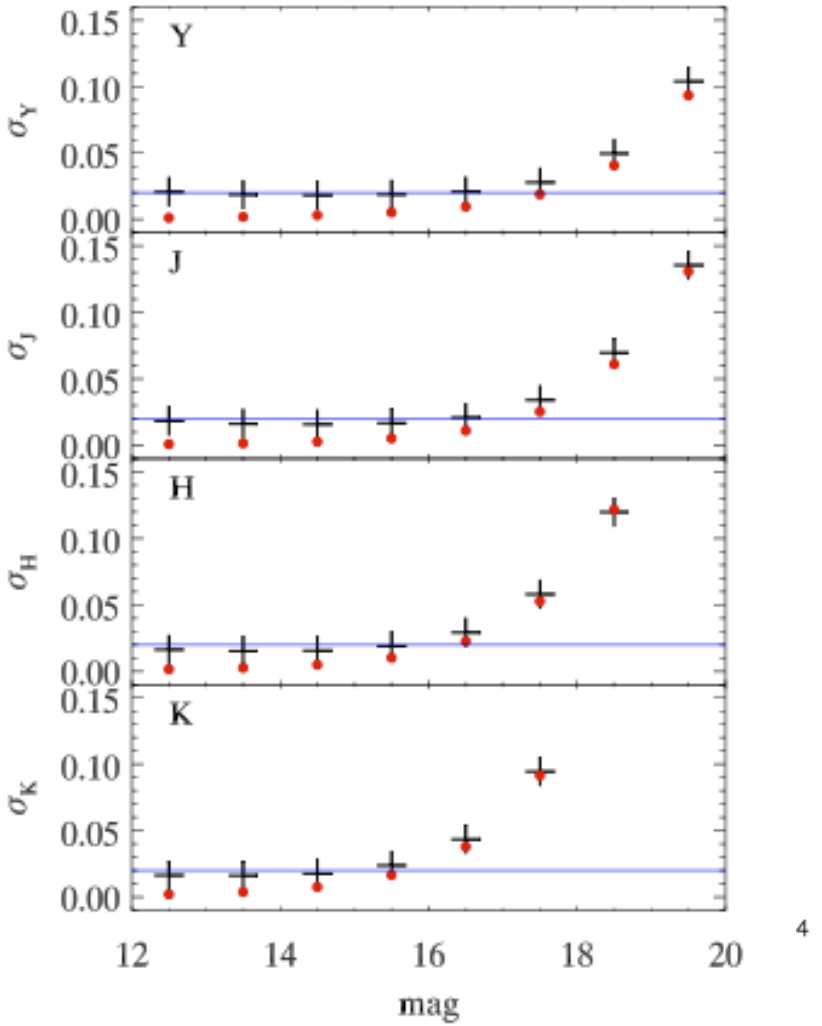
NIR photometric calibration 2MASS

per pointing 2MASS calibration

individual detector zero-points

astrometric distortion correction

illumination correction per band



NIR photometric calibration 2MASS

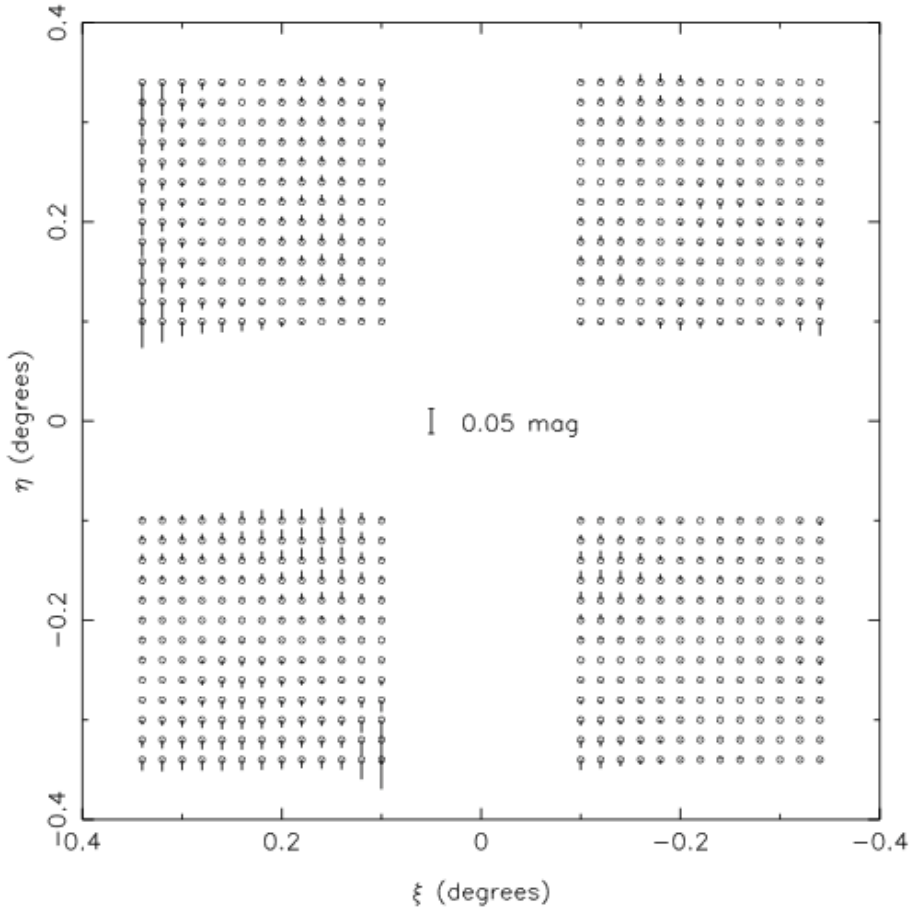
per pointing 2MASS calibration

individual detector zero-points

astrometric distortion correction

illumination correction per band

J-band Sept 05B illumination correction



END